Testimony of

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Former Director of the Spectrum Policy Task Force
Federal Communications Commission

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Mr. Chairman, Ranking Member, and Members of the Committee:

Good morning. I am Dr. Paul Kolodzy, and I would like to thank you for this opportunity
to appear before you today. Until December, 2002, I served as the Director of the Spectrum
Policy Task Force at the Federal Communications Commission. I currently serve as the Director
of the Center for Wireless Network Security and as a Professor in the Schools of Engineering
and Technology Management at the Stevens Institute of Technology in Hoboken, New Jersey.

At the present time, I am under contract as a part-time expert consultant to the FCC, but I
want to emphasize that I am here today in my own individual capacity pursuant to the
Committee's invitation. Accordingly, my testimony is based on my staff level work with the
Spectrum Task Force and does not necessarily reflect the views of the Commission. I was
fortunate to have the support of my FCC colleagues, some of whom are behind me, in preparing
for this hearing today.

I am very grateful to the Committee for this opportunity to testify on the important topic
of the future of U.S. radio spectrum policy. In my position as the Director of the Spectrum
Policy Task Force from March to December 2002, I oversaw a comprehensive assessment of the
Commission's current spectrum policy models, the development of new approaches to
"managing" the spectrum resource, and the completion of the Task Force's report.   Chairman
Powell commissioned the Task Force to develop policies to advance spectrum reform, one of his

six strategic goals for the agency.   We have been overwhelmed by the positive response to our

Report so far, as well as the tremendous interest in the important work of the Task Force.

The Task Force has only just begun the process of reexamining 90 years of spectrum

policy to ensure that the Commission's policies evolve with the *consumer-driven* evolution of

new wireless technologies, devices, and services. A close examination of current spectrum

policies, even with the innovative legislative and regulatory changes that occurred in the 1990s,

shows that government spectrum management is still based on the environment that existed in

the1920s and 30s: AM broadcast radio, ship-to-shore communications, and Ham operators.

Although those uses are still important components of the communications mosaic, these

services no longer represent the majority of the systems nor are they indicative of the

technologies that comprise modern telecommunications services.

My testimony will first provide some brief background on the Spectrum Policy Task

Force. Then I will summarize the key findings and recommendations contained in the Task

Force Report.

Background

FCC Chairman Michael Powell established the Spectrum Policy Task Force in June,

2002 to assist the Commission in identifying and evaluating specific changes in spectrum policy

that would increase the *public* benefits derived from the use of radio spectrum. Chairman Powell

directed the Task Force to analyze spectrum allocation, assignment and use and to develop a plan

of action for review by the Commission. The creation of the Task Force initiated the first ever

comprehensive and systematic review of spectrum policy at the FCC.   In announcing the

formation of the Task Force, the Chairman set forth its core mission:

- Provide specific recommendations to the Commission for ways in which to evolve the current "command and control" approach to spectrum policy into a more integrated, market-oriented approach that provides greater regulatory certainty, while minimizing regulatory intervention; and

- Assist the Commission in addressing ubiquitous spectrum issues, including interference protection, spectral efficiency, effective public safety communications, and international spectrum policies.

The Task Force is composed of a team of seasoned professionals from across the FCC's Bureaus and Offices, including engineers and economists, as well as lawyers and public policy experts. The Task Force recognized that our work could not be completed without significant input from sources outside of the FCC. We endeavored to create a transparent process that encouraged and facilitated substantial public participation and tapped all available expert resources. As soon as the Task Force announced its official organization and work plan in June 2002, we released a Public Notice seeking comment on a wide range of spectrum policy issues.

We received over 200 comments and reply comments from many individuals and entities, including equipment and consumer electronics manufacturers, wireless Internet service providers, radioastronomy interests, satellite and broadcast companies, consumer groups and individual consumers, fixed and mobile wireless service providers, academics, economists, scientists, engineers, public safety organizations, state and local governments, consultants, journalists, telecommunications bandwidth brokers, energy and transportation interests and rural telephone companies.

In August, the Task Force held public workshops over four separate days and utilized the services of over 70 expert panelists from government, industry, academia and the public. Each workshop focused on a specific aspect of spectrum policy: (1) Spectrum Rights and Responsibilities; (2) Spectrum Efficiency; (3) Interference Protection; and (4) Experimental Licenses and Unlicensed Spectrum. Approximately 75 expert panelists and outside moderators participated, representing a cross-section of all interested parties.

With the benefit of this tremendous public input, the Task Force developed several findings and made 39 specific recommendations to the Commission. Before submitting them to the full Commission, these recommendations were presented to and vetted by the members of the FCC's Spectrum Policy Executive Committee, which is made up of the Bureau and Office Chiefs from the internal FCC organizations engaged in spectrum activities. On November 7, 2002, I appeared before FCC Chairman Powell and his fellow Commissioners at an open meeting and presented the Task Force's findings and recommendations. We released the Report in November and the full Commission issued a Public Notice seeking public comment on the Report. In the first round alone, the FCC has received over 80 formal comments on the Report.

The Task Force Report ultimately concluded that the regulatory structure governing spectrum management is outdated, cumbersome and lacks the requisite flexibility to foster technological innovation and economically efficient spectrum use. Addressing these matters is particularly important because spectrum-based services play such an essential role in the Commission's other strategic goals, including broadband, competition, the DTV transition, and homeland security. I will now highlight some of the key findings and recommendations that the Task Force made to the Commission.

Task Force Findings

There has been a dramatic increase in overall demand for spectrum-based services and devices, accompanied by particular demand for mobile and portable spectrum-based applications. This is true for both traditional, licensed services and for services offered through unlicensed devices. This increased demand is propelled by a host of factors: the economy has moved towards the communications-intensive service sector, the workforce is increasingly mobile, and consumers have been quick to embrace the convenience and increased efficiency of the multitude of wireless devices available today. Today, a myriad range of unanticipated innovations and changes continually challenge the ability of regulators to keep pace. It has become readily apparent that the speed of technological change has increased over the last few decades, creating an environment where flexibility and innovation should guide regulatory policies.

While the Task Force recognized the societal trends that have contributed to the increased demand for spectrum-based services and devices, we also understood that it is difficult to make accurate projections of future demands. Historically, both industry and Commission projections for spectrum use have significantly and consistently underestimated the demand for additional spectrum resources and the public's utilization of new technologies and applications.

Four principal findings of the Spectrum Policy Task Force provide the foundation for our recommendations. These and other findings were used to formulate recommendations to the Commission. Let me briefly outline these four findings and discuss some of the issues related to our work.

Spectrum Access versus Scarcity

The growth in demand for spectrum-based services and devices requires many spectrum users to seek additional spectrum. This leads to the appearance that spectrum demand is outstripping spectrum supply. Indeed, most "prime" spectrum has already been assigned to one or more parties, and it is becoming increasingly difficult to find spectrum that can be made available either for new services or to expand existing ones.

The Task Force determined that spectrum *access* is a much more significant problem than *scarcity*. The Task Force collected and reviewed preliminary data regarding spectrum usage that show that significant spectrum capacity remains untapped. Currently, no federal agency or other organization systematically measures actual spectrum use. While additional and more comprehensive spectrum measurements can and should be undertaken to improve the understanding of actual spectrum use, these preliminary measurements are quite revealing. If the Commission were to facilitate greater access to the vacant "white spaces" of the radio spectrum, the effects of the physical scarcity of the spectrum resource could be minimized.

The Task Force concluded that improving access to the spectrum can be achieved through permitting licensees greater flexibility. Licensees often have variable needs and therefore do not use their spectrum for particular periods of time or in certain geographic areas. At the same time, due to regulatory restrictions, licensees are usually unable to make their spectrum available to others, even if a market exists to do so. Granting licensees additional flexibility to make their licensed bands available to others would increase access to the spectrum and, correspondingly, minimize the real prospect of spectrum scarcity.

New Methods as a Solution to Access

Second, the radio spectrum can be parceled in time, space, and frequency. Historically, due in large part to technological limitations in radio performance, the Commission's spectrum policies have parceled – or assigned – spectrum according to particular operational frequencies and geographic areas of operations. Past policies also dictated the power at which radio transmitters must operate. Smart technologies, such as low power processors, frequency agile transmitters, digital receivers, and other technologies potentially allow operators to take advantage of the time dimension of the radio spectrum. That is, because their operations are so agile and can be changed nearly instantaneously, they can operate for short periods of time in unused spectrum.

The Commission's current policies generally do not take into account the time dimension of spectrum use. In addition, the Commission's current policies do not effectively support the ability of new technologies to take advantage of geographic white space. In order to be responsive to these increased technological capabilities, the Task Force concluded that, while the Commission's spectrum policies can and should remain technology agnostic, they should not be technology antagonistic. As a result, the Task Force suggested that the Commission should strive, wherever possible, to eliminate regulatory barriers to increased spectrum access as new technologies provide new and innovative means to access the spectrum.

Interference Tolerance

Third, technology advances are also allowing systems that use radio spectrum to be much more tolerant to interference. While technological advances are contributing to the increased diversity of spectrum-based consumer applications, the Task Force acknowledged that there are

technological advances that also are providing some potential answers to current spectrum policy challenges concerning interference avoidance and mitigation.

Growth in the use of digital spectrum-based technologies not only increases the potential throughput of information, it also has potentially significant ramifications for interference management. Digital signals are inherently more robust and resistant to interference than analog signals. Moreover, digital signal processing techniques, such as coding and error correction, are more effective at rejecting interfering signals. Thus, spectrum policies can and should reflect this increased ability to tolerate interference. Moreover, given the increased ability of new technologies to monitor their local RF environment and operate more dynamically than traditional technologies, the predictive models used by the Commission can be updated, and perhaps eventually replaced, by techniques that take into account and assess actual, rather than *predicted,* interference levels.

Need to Define Rights and Responsibilities

Fourth, all spectrum users require clear rules governing their interactions with the Commission and other spectrum users. Regardless of how or to whom particular rights are assigned, ensuring that all rights are clearly delineated is important to avoiding disputes, and provides a clear common framework from which spectrum users can negotiate alternative arrangements. Currently, spectrum users' rights and obligations are often not defined with sufficient clarity.

An example of this is in defining "harmful" interference, which is one of the primary parameters of the bundle of spectrum rights granted to licensees. But stakeholders in spectrum policy debates can subject the standard of "harm" to multiple subjective opinions and use it to

block or delay new services and devices from being introduced into the market. Given the increasing flexibility in the types of spectrum-based services and, correspondingly, more intensive use of the radio spectrum, the spectrum user and the potential interferer need more certainty about the metrics that determine rights of protection and access. This is particularly important for incumbent providers who have invested substantial sums in building their networks and providing highly valued services to the public. Therefore, the Task Force concluded that there needs to be, wherever feasible, a more quantitative approach to interference management. Quantitative standards reflecting real-time spectrum use would provide users with more certainty and, at the same time, would facilitate enforcement.

Task Force Recommendations

Based on these key findings, the Task Force set forth four key recommendations and a total of 39 separate recommendations to the Commission.

Modernizing the Regulatory Model

The Task Force's first recommendation is to migrate from the current command and control model to the more market-oriented exclusive rights and unlicensed device/commons models. The Task Force agreed with the consensus view expressed by participants in the Task Force process that "one size does not fit all" in spectrum policy. An examination of the exclusive use and commons models as they have been applied suggests that each model has encouraged beneficial types of technical and economic efficiencies. The Task Force recommended that the Commission base its spectrum policy on a balance of the three basic spectrum rights models: an exclusive use approach, a commons approach, and (to a more limited

degree) a command and control approach. Specific recommendations in furtherance of this objective include:

- Permit maximum flexible use of spectrum by both licensed and unlicensed users. This would enable spectrum users to make fundamental choices about how they use spectrum, taking into account market factors such as consumer demand, availability of technology and competition.

- Clearly and extensively define spectrum users' rights and responsibilities.

- Provide incentives for efficient spectrum use.

- Investigate rule changes that promote the lowering of permitted power in congested areas and the increasing of permitted power in uncongested areas, particularly rural environments.

Increase Access to Spectrum

The Task Force's second major recommendation was to implement ways to increase access to the spectrum for both unlicensed and licensed users. Advances in technology that provide access in time, as well as in frequency, bandwidth, and space, of the spectrum also provides a window to new opportunities for using the radio spectrum. The Task Force recommended that the Commission consider the use of time in permitting more dynamic allocation and assignment of spectrum usage rights. Four of the recommended methods to use time are: (1) to act in its pending secondary markets proceeding; (2) to permit the use of more dynamic allocations and assignment of spectrum usage rights; (3) to permit more flexible use, albeit within technical parameters, of the allocations under licensee control; and (4) allow

traditionally narrow services, such as public safety, to lease excess capacity to other non-related services.

New Interference Management Techniques

The Task Force's final "core" recommendation was to implement a new paradigm for interference protection. As the Commission considers how to provide opportunities for an ever-increasing array of spectrum-based technologies and services, one recurring and often thorny issue is how to protect users against harmful interference. Ensuring adequate interference protection has been a key responsibility of the Commission since its inception and continues to be one of its core functions. The Task Force believed that, although the Commission's rules and processes for managing interference have historically been effective in many bands, current interference management approaches and tools need to be reexamined in light of the dramatic changes in technology and uses of the spectrum.

The Task Force suggested that, as a long-term strategy, the Commission shift its current paradigm for assessing interference – based on transmitter operations – toward basing policy more on what results at receiver locations. The Commission currently performs detailed calculations of expected interference environments, and determines transmitter requirements based on "worst case" analysis. This methodology has generally been adequate and has been the foundation for successful spectrum management for the past several decades. With more intensive use of the spectrum, coupled with highly mobile devices, a more dynamic, *in-situ* methodology will be necessary. Specifically, the Task Force recommended that, on a going forward basis, the Commission adopt a new metric – the "interference temperature" – to quantify and manage interference. The interference temperature would be a localized measurement

defining the interference environment at or around the device. The Commission could use the interference temperature metric to establish maximum permissible levels of interference, on a band-by-band basis, thus establishing a clearly defined expectation of the noise environment in which the receiver would be operating. To the extent, however, that the interference temperature in a particular band is not reached, other users could operate more flexibly – with the interference temperature serving as the maximum cap on the potential RF energy they could introduce into the band.

Legislative Recommendations

In furtherance of the broader goals for changes in spectrum policy outlined by the Task Force, it also advised that the Commission should consider making legislative proposals for submission to Congress. These recommendations to the Commission are the result of a thorough examination of the current statutory structure contained in the Communications Act of 1934, as amended, as well as related laws. The Task Force proposals were intended as a blueprint for the Commission to use in its interactions with Congress to reexamine the broader U.S. spectrum policy regime.

Conclusion

The FCC's Spectrum Task Force Report is the culmination of an analytical and transparent process designed to carefully examine the status of our national spectrum policy and make recommendations for modernizing it to match current and future technological and market environments. I am extremely honored to have been a part of this endeavor and grateful for the bold vision of Chairman Powell, who recognized the critical need to undertake a comprehensive

review of this area. The work of the Task Force was systematic and thorough, and involved the participation of an extensive array of interested parties.

But the work has just begun. It is the my hope and expectation that the work of the Task Force, as well as the contributions of many others including those sitting at this table, will provide the basis for important policy changes that will lead to technological innovation and, most importantly, increased consumer benefits. I am excited about the building momentum and ongoing debate for rethinking these decades-old policies.

Again, I appreciated this opportunity to appear before the Committee and I would be pleased to answer your questions at this time.